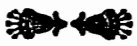
GOVERNMENT OF GUJARAT

MANUAL
ON
DESIGN OF CHECK DAMS



PUBLIC WORKS DEPARTMENT

SACHIVALAYA

GANDHINAGAR

MANUAL ON CHECK DAM

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CHECK DAM

1.0 DEFINITION :

Check dam is a low weir without a canal off taking from it, but affording facility for lift irrigation and also firming up, by means of percolation, irrigation under the wells in the surrounding area. It also helps in recharging the aquifers which are depleted by wells, tubewells etc.

It is generally provided on small streams or nallas having a continuous flow, particularly during the Rabi season. At least there should be a minimum flow of 0.03 cumecs (One cusec) even one month after the rainy season.

2.0 INVESTIGATION :

2.1 SITE SELECTION :

Check dams should be resorted to only where a minor irrigation tank or a bandhara is not feasible.

The following points should be kept in mind when the site for a check dam is being investigated.

(i) The stream should have a straight reach of at least 300 M. on the U/s and D/s of the proposed site.

(ii) The banks of the stream should be fairly high and stable.

(iii) Good foundation should be available at reasonable depth.

(iv) Irrigable land, wells should be available on both the banks of the stream within a radius of 800 mt ($\frac{1}{2}$ mile).

2.2 SURVEY & DATA COLLECTION :

The following data, should be collected at the time of investigation—

(i) The catchment area at the proposed site.

(ii) The cross section of the nalla at the proposed site.

(iii) Maximum flood level observed. This level may be inquired from the persons residing nearby and also from the flood marks.

(iv) Contour survey of the area. This survey should be extended upto 0.5 mt. above the expected affluxed H. F. L. on the up stream and up to 300mt. length on the downstream side of the proposed site.

(v) L. S. of the stream on the up stream side should be extended up to 0.5 mt. beyond the affluxed H. F. L. and on the downstream up to 300 mt.

(vi) Strata available for the foundation.

(vii) Number of wells existing and the Irrigable area available within a radius of 800 mt. ($\frac{1}{2}$ mile) from the proposed site.

(viii) The ground level near the wells, water level and the strata met with in the wells. The fluctuation in the water levels may also be indicated.

(ix) Minimum three trial pits one in the centre of the stream and one on each bank where the wall or abutment of the check dam would be located should be taken.

(x) The discharge data of the stream at or near the proposed site for atleast the previous three years should be collected. If this data is available for one or two years only, the figures of the discharge should be correlated with the normal years rainfall and the probable discharge in the normal year may be worked out.

(xi) Rainfall figures from the nearby raingauge stations should be collected. If the rainfall figures near the proposed site are not available, the rainfall figures of the river or nalla having the same geographical characteristics should be adopted.

3.0 DESIGN :

3.1 DISCHARGE :

As already stated in para 2.2. (×), the discharge data if available for a number of years would facilitate in determining the Discharge which could be expected in the stream in a normal year.

3.2 Flood Discharge :

In case of check dams the flood to be considered in the designs should be judiciously fixed. Usually the maximum discharge which is observed or the discharge based on Dicken's formula, whichever is higher is adopted in the design calculations.

3.2.1 Observed flood discharge :

Flood marks noticed near the proposed site or as inquired from the local persons, if judiciously used will give the maximum discharge carried by the stream. The discharge may be computed from the equation

$Q = AV$

where Q = Discharge in cumecs (Cusees)

A = Cross sectional area of the stream in sq.Mt. (sq.ft.)

V = Velocity in Mt. per Sec. (ft per sec.)

The velocity V is worked out as per Mannings Formula given below :

$$V = \frac{1.486}{N} \times R^{2/3} \times S^{1/2} \text{ in F. P. S. system. or}$$

$$V = \frac{1}{N} \times R^{2/3} \times S^{1/2} \text{ in M. K. S. System}$$

Where N = Coefficient of Rugosity
R = Hydraulic Mean Depth.
S = Slope

3.2.2 Dicken's Formula :

This is an empercial formula and is given by the equation :

$$Q = C A^{3/4}$$

Where Q = Discharge in cusecs.
C = Constant.
A = Catchment area in sq. miles.

The value of C depends on the catchment area and is usually assumed as under :—

C. A. (in sq. miles)	Value of C
Below 30	2400
30 —100	2200
100 —300	1900
300 —1000	1500

Though the maximum designed flood discharge is based either on Dicken's formula or observed flood, whichever is higher, it should be seen that the encroachment on the free-board when. the flood worked out on the basis of Inglis formula is adopted is not more than 25 per cent The Inglis formula which is an emperical one is as under :—

$$Q = \frac{7000\ A}{\sqrt{A} + 4}$$

Where Q = Maximum discharge in cusecs.
A = Catchment area in sq. miles.

3.3 Length of Check-Dam:

Depending on the site condition, the length of the check dam should be fixed in such a way that the afflux caused by the obstruction is minimum possible. The afflux is worked out as per Molesworth equation given below :—

$$h = \left(\frac{V^2}{58.6} + 0.05\right) \times \left[\left(\frac{A}{a}\right)^2 - 1\right]$$

where h = Afflux in ft.
V = Velocity in ft./sec. in the stream upstream of the proposed site-
A = Unobstructed water-way of the stream in sft.
a = Obstructed waterway of the stream in sft.

Where the banks of the stream are not high enough to confine the affluxed H. F. L. between them, piers with provision for inserting wooden needles for raising the water level are provided instead of a continuos body-wall across the stream.

3.4 STABILITY ANALYSIS :

Generally, the height of the check dam will not exceed 1.5 to 2.0 meters above the bed of the stream. The stability analysis will be similar to the one adopted in case of pick-up weirs. The section of the check dam should be checked for the following conditions :—

(i) Water upto the crest of the check dam on the upstream side and no water on the downstream

(ii) Maximum water levels both on the upstream and downstream sides.

(iii) Water level upto the crest on the down stream side with corresponding level on the upstream side.

An uplift factor of 50% should be considered in the design calculations.

Where wooden needles are provided, the length of the needle should not exeed. 1.8 mts. (6 ft.) The thickness of the needle should be 7.5 cms (3 inches.) Needles are generally provided in two rows with a gap of 30 cms. to 45 cms. (1 to 1.5 ft.) between them. The gap is filled up with clay to prevent leakage of water. Such needless may be provided upto a maximum height of 1.25 mts (4 ft) Typical sketches of the pier and the grooves to accommodate the needles are given in Sketch No. 1

3.5 ENERGY DISSIPATION :

As the height of the check dam will not be much, only a water cushion chamber should serve the purpose of dissipating the energy of falling water where rock is exposed or available within a depth of 0.5 meter, no water cushion chamber need be provided.

3.6 EARTHEN FLANKS :

Normally, the masonry portion of the check dam is keyed into the flanks, and no earth work on the flanks would be necessary. However, when the site conditions warrant an earthen bund, the standards as adopted in case of percolation tanks should be followed.

4.0 DRAWINGS :

The following drawings should accompany the proposal for a check dam. :—

(i) Index Plan (Scale 1″=1 mile) showing the proposed site and its catchment, nearest village or town, existing roads.

(ii) Contour Plan (Scale 1 cm.=10 mts. to 30 mts.) This should extend upto atleast 1.5 meters above the anticipated affluxed H.F.L. on the upstream side and for at least 300 meters on the downstream side of the proposed check dam.

(iii) Village Plan (Scale 1″=330 ft. or 660 ft.) showing the location of check dam, land and structures going under the submergence, existing wells, proposed wells, area benefitted by the existing wells, area benefitted by lift irrigation etc.

(iv) Plan, L.S. & C.S. of the check dam. The details of the strata available as per the trial pits should also be indicated on the L.S. These drawings should be drawn to the following scale.

for Plan ..		scale	1 cm.=5 mts. to 20 mts.
for L.S. ..	Horizontal	scale	1 cm.=5 mts. to 20 mts.
	Vertical	scale	1 cm.=0.5 mt. to 1 mt.
for C.S. ..	Horizontal scale		1 cm.=1 mt. to 5 mts.
	Vertical scale		,,

(v) L.S., C.S. and plan of the stream showing the location of the check dam, location and detail of trial pits, H.F.L. etc.

5.0 IRRIGATION & BENEFITS :

As already mentioned the check dams affords facility for lift irrigation and also firms up irrigation under the wells by means of percolation into the wells. The extent of lift irrigation can be worked out on the basis of the minimum post-monsoon flow. For this purpose an average area of 100 acres per cusec may be assumed.

The increase in the irrigation benefits due to percolation depends on the nature of starata available in the bed and sides of the stream and also on the number of wells existing and proposed within a reasonable area from the proposed site. The actual benefits achieved by the existing check dams on the same stream or similar streams will facilitate in working out the anticipated benefits by the proposed check dam.

6.0 COST CRITERIA :

As check-dams are mainly taken up as protective works rather than productive works not much importance is to be attached to the benefit cost ratio. However, the cost of the check dam should not exceed Rs. 3.00 lakhs, and the M & R expenditure will have to be entirely borne by the Panchayat concerned. In special cases where the cost exceeds Rs. 3.00 lakhs, permission of the Government would be necessary before taking up the work.